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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/784,756	02/23/2004	John McKenna Brennan	5-84-2-6	2203

7590 05/17/2005

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EXAMINER

PAREKH, NITIN

ART UNIT PAPER NUMBER

2811

DATE MAILED: 05/17/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/784,756	BRENNAN ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	Nitin Parekh	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 02 May 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 February 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>04-05-04</u> | 6) <input type="checkbox"/> Other: _____  |

### **DETAILED ACTION**

1. Applicant's election with traverse of claims of Group I in the reply filed on 05-04-04 is acknowledged. The restriction requirement set forth in the previous office action is withdrawn based on the arguments in response to the restriction requirement.

### ***Drawings***

2. Figures 1A/1B should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

### ***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 2, 5-10, 14 and 17-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Joshi et al. (US Pat. 5955781).

Regarding claims 1, 2 and 5 and 10, Joshi et al. disclose a semiconductor device (see Fig. 3) and a method/steps of making such device comprising:

- a semiconductor/silicon substrate (106 in Fig. 3)
- an active region formed in the substrate proximate an upper surface of the substrate (see device/gate-junctions region in Fig. 3), the active region including at least one circuit element formed therein
- a plurality of trenches/channels (108 in Fig. 3) formed in a back surface of the substrate opposite the upper surface of the substrate, the trenches /channels being formed proximate the active region
- the trenches/channels being substantially planar with the back surface of the substrate, and
- wherein the trenches/channels are filled with a thermally conductive material/TCM (see 102 in Fig. 3) such as diamond, the TCM having a thermal conductivity (TC) being greater than that of the substrate (see Table 1) and being configured so as to provide a thermal conduction path for conducting heat away from the active region (Col. 5, line 60- Col. 6, line 5)

(Fig. 3; Col. 4, line 15- Col. 6, line 5; Col. 1-8).

Regarding claims 6- 9, Joshi et al. disclose the entire structure as applied to claim 1 above, wherein Joshi et al. further teach:

- the trenches/channels comprising substantially v-shaped grooves having sloped sidewalls (see Fig. 2C; Col. 5, lines 25-52), and
- the trenches/channels being formed using an etching process comprising anisotropic etching (Col. Col. 5, line 65; Col. 6, line52; Col. 8, lines 25-28).

Regarding claim 14, Joshi et al. disclose the entire structure as applied to claim 1 above, wherein Joshi et al. further teach the device structure comprising a plurality of active devices/regions being formed in the upper surface of the substrate such that each of the trenches/channels are proximate a corresponding one of the active devices/regions to provide the desired heat dissipation for the structure (Col. 2, lines 60-65).

Regarding claims 17-19, Joshi et al. disclose the steps/method of forming the device as applied to claim 1 above.

Regarding claim 20, Joshi et al. disclose the entire structure as applied to claim 1 above, wherein Joshi et al. further teach the device structure comprising a cooling tower/base (120 in Fig. 5) wherein an integrated circuit die/chip (122 in Fig. 5) is attached to the base to provide a thermal conduction path between the active region

and the base for conducting heat away from the active region (Fig. 3 and 5; Col. 6, lines 16-25).

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 3, 4, 11, 12, 15 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Joshi et al. (US Pat. 5955781)

Regarding claims 3, 4 and 12, Joshi et al. teach the entire structure as applied to claim 1 above, except the TCM comprising a metal or at least one of copper, aluminum, gold, silver, a copper alloy, and an aluminum alloy.

Joshi et al further teach using TCM including metals such as tungsten, copper, aluminum, etc. (see Col. 6, lines 43-47; Col. 7, lines 25-27) to provide improved heat dissipation for the device. Furthermore, the metal such as tungsten has a coefficient of thermal expansion (CTE) substantially matching to that of the substrate (see Table 1).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the TCM comprising a metal or at least one of

copper, aluminum, gold, silver, a copper alloy, and an aluminum alloy in the channel so that the device processing can be simplified and the material handling/cycle time can be improved in Joshi et al's device.

Regarding claim 11, Joshi et al. teach the entire structure as applied to claim 1 above, wherein Joshi et al. further teach the trenches/channels having the TCM being formed in the selected regions or the region adjacent or alongside/lengthwise the active regions of the device (Col. 7, lines 5-9; Col. 8, line 26), but fail to teach at least one channel being formed through a length of the device between opposing sides of the device.

The determination of parameters such as size/dimension including length/width, height, thickness, spacing, etc. of the active region/source-gate-drain, metal interconnect, thermally conductive via/plug, substrate/heat sink/thermally conductive structure, etc. in chip packaging and interconnect technology is a subject of routine experimentation and optimization to achieve the desired thermal/electrical performance, speed, reliability and yield.

It would have been obvious to a person of ordinary skill in the art at the time invention was made to select at least one channel being formed through a length of the device between opposing sides of the device so that the thermal dissipation can be improved in Joshi et al's device.

Regarding claims 15 and 16, Joshi et al. teach the entire structure as applied to claim 1 above, wherein Joshi et al. further teach the trench/channel being approximately 2-10 microns from a surface of the substrate (see Fig. 2C), but fail to teach at least one channel being formed having a maximum height that is about two thousandths of an inch from the upper surface of the substrate or about forty micrometers from the active region.

The determination of parameters such as size/dimension including length/width, height, spacing, etc. of the active region/source-gate-drain, metal interconnect, thermally conductive via/plug, substrate/ thickness, etc. in chip packaging and interconnect technology is a subject of routine experimentation and optimization to achieve the desired thermal/electrical performance, speed, reliability and yield.

It would have been obvious to a person of ordinary skill in the art at the time invention was made to select at least one channel being formed having a maximum height that is about two thousandths of an inch from the upper surface of the substrate or about forty micrometers from the active region so that the desired thermal dissipation, electrical performance can be achieved and the reliability/yield can be improved in Joshi et al's device.

7. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Joshi et al. (US Pat. 5955781) in view of the admitted prior art (APA).



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Regarding claims 13, Joshi et al. teach the entire structure as applied to claim 1 above, except the device having a cross-sectional thickness greater than or equal to about six thousandths of an inch.

The APA teaches devices having six mils or more (specification pp. 1)

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the device having a cross-sectional thickness greater than or equal to about six thousandths of an inch as taught by the APA so that warpage can be reduced in Joshi et al's device.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nitin Parekh whose telephone number is 571-272-1663. The examiner can normally be reached on 09:00AM-05:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9318.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

NP

05-11-05



NITIN PAREKH

PRIMARY EXAMINER

TECHNOLOGY CENTER 2800